(12) EUROPEAN PATENT APPLICATION

(71) Applicant: **N.V. Philips' Gloeilampenfabrieken**
Groenewoudseweg 1
NL-5621 BA Eindhoven(NL)

(72) Inventor: van Steenbrugge, Bernard
c/o INT. OCTROOIBUREAU B.V. Prof.
Holstlaan 6
NL-5656 AA Eindhoven(NL)

(74) Representative: Faessen, Louis Marie
Hubertus et al
INTERNATIONAAL OCTROOIBUREAU B.V. 6
Prof. Holstlaan
NL-5656 AA Eindhoven(NL)

(54) Local communication bus system comprising a set of interconnected devices, a control bus, and a set of signal interconnections, and a device and a switchbox for use in such system.

(57) In a local communication bus sytem there exist terminal devices (40.42.44.46.52.54.56.58) and switchbox devices (48,50). All devices are interconnected by a single-channel control bus (60), that is used for establishing and retiring pairwise signal interconnections between the devices. The switchbox contains an interconnection table, specifying which plug of which other device is connected to each of its own plugs. No global control is necessary. Neither is a complete picture of all signal interconnections required in any one device.

EP 0 432 316 A1

LOCAL COMMUNICATION BUS SYSTEM COMPRISING A SET OF INTERCONNECTED DEVICES, A CONTROL BUS, AND A SET OF SIGNAL INTERCONNECTIONS, AND A DEVICE AND A SWITCHBOX FOR USE IN SUCH SYSTEM.

BACKGROUND TO THE INVENTION

The invention relates to a local communication bus system comprising a serial control bus attached to a plurality of devices, that are furthermore pairwise interconnected by respective signal interconnections and

5 include at least one plural-interconnected switchbox means, said system being able to establish a signal path between an initiating or source station and a destination station. A single-channel control bus has been described in United States Patent 4,429,384 (PHN 9737), herein incorporated by reference. Such a communication bus is particularly suited for transfer of control signals between various devices for consumer entertainment, devices for executing household chores, and devices for producing various

10 maintenance and management control signals in a domestic environment. A different kind of serial bus has been disclosed in US Patent 4,689,740. This particular serial bus has separate clock and data wires. A still different set-up is a single data wire, a single clock wire, and a single word enable wire. A still different set-up is a single data wire, a single bit synchronization wire, and a single word synchronization wire. Serial in this context means that the information transmitted is represented by at most two wire signals, any other

15 wire being exclusively used for controlling and/or synchronizing the transfer. For simplicity, only the system according to the first referenced pattern is considered hereinafer. In addition to the control bus, the various devices are pairwise interconnected by signal interconnections. Herein, pairwise means that either exactly two devices are interconnected, or that one particular device operates as signal source, whereas the others function exclusively as signal destinations. An example would be one audio amplifier that can selectively

20 power either one of two (or more) loudspeaker boxes. The signals may be analog or digital and may relate to audio or video information or other. Certain devices, although attached to the control bus, need not be interconnected to such signal interconnection inasmuch as they have little or no signal handling facilities, such as switches, sensors etcetera. For these devices, the control bus would provide a data path of sufficient transport capability. Particular properties of such system are the low level of data processing

25 facilities of many of the interconnected devices, and also the frequent configuration changes encountered inasmuch as many devices are portable and liable to plugging and unplugging in various physical attachment points of the control bus. In typical circumstances, such control bus could be wired to all rooms of a house or appartment and in each wired room have one or more wall-mounted plugs. Of course simpler configurations would also do. The devices often have only a single signal interconnection; anyway, the

30 switchbox means have at least two such signal interconnections, typical values are four to six.

SUMMARY TO THE INVENTION

Among other things, it is an object of the present invention to allow for easy and error-free establish-
35 ment of a signal path between a source device and a destination device without the need for either a central control device or for the storage of all present and valid pairwise signal interconnections in each relevant device, but allowing for only the storage in each device of a local interconnection table.

It is a further object of the present invention to allow for an easy and error-free establishment of a signal path between a source device and a destination device by providing a protection of a signal path once
40 established. It is another object of the invention to prevent a signal path established before from destruction or interference by a signal path to be established before without knowledge of the user.

Among other things, it is still a further object of the invention to provide an automatic priority system for signal paths, so that the user is not unnecessarily troubled with decision making on signal paths to be established and signal paths to be cancelled. The invention, according to one of its aspects, thereto
45 provides a local communication bus system comprising a serial control bus attached to a plurality of devices that furthermore are plug to plug pairwise interconnected by respective signal interconnections and include at least one plural-plug switchbox means, said system for establishing and specifying a signal path between a source device and a destination device comprising:

- in each respective device, interconnection table means interrogatibly storing information indicating any
50 other device pairwise interconnected to said respective device, the plug pair so interconnecting that other device and a priority code if any for each interconnection;
- in said source device first message generating means for generating, in case said source device and destination device are not pairwise interconnected, on said control bus a messaged Connect control

command including a priority code directed to any first switchbox means pairwise connected to said source device and indicating said destination device as well as the priority of the connection to be made and in conjunction therewith a messaged Select control command directed to said destination device for thereto signalling and specifying said establishing;

- in the first switchbox means so directed at, interrogating means for interrogating its interconnection table means for identifying the plug connected to said destination device if any and for interrogating the stored priority code if any, and control means for comparing the stored priority code and the received priority code and for in the negative case controlling said first switchbox means as secondary source device for producing a further Connect control command including the priority code received by said first switch box to any second switchbox means connected thereto, until after a first sequence of such Connect control commands the destination device is reached. thereby said signal path is identified as a second sequence of such pairwise interconnections, between associated plug pairs. starting from said source device and terminating in said destination device. whereby said destination device is activated by said Select control signal for effecting the intended signal transfer, said system comprising activating means for in an initializing state activating said interconnection table means.

In this respect, the source device is the source of the control message; on the level of the signal transfer it may operate either as signal source, or as signal destination. Now each device has an interconnection table that must only store a list of all local plugs, explicit or implicit, the name or other indication of the device connected thereto, the latter device's plug used for realizing the interconnection and the priority code if any for each interconnection. The plug may be a physically separated interconnection to a single signal path that is privy to the devices interconnected thereby, the switching being by means of physically exerting connections and disconnections, as the case may be. Alternatively, the switchbox means may interconnect its plugs by means of frequency selecting, in that the signal frequency band on a first plug determines which of the other, frequency-sensitive plugs be connected thereto. In consequence: frequency multiplexing is effected on the first plug. Each switchbox, at any time may interconnect two or more of its plugs. or interconnect plural pairs of its plugs. Before a connection will be made the interrogation means read the stored priority code from the interconnection to be made from the interconnection table means and compare the stored priority code with the priority code, which has been received by the device. If the latter overrules the stored priority code (negative result) then the interconnection is made or a messaged Connect Control Command is sent to a second switch box means. all given the condition that the destination device or the second switch box means is present.

Now, if the first switchbox means is not pairwise connected to the intended destination device. it will, by means of the control bus, operate as secondary source device and search any further switchbox means pairwise connected to it; this operation may be executed in a tree organization. In general. the search will terminate after accessing of only a few switchbox means in sequence.

In the above, the Connect control command indicates which device is to operate as destination device (for the control); the Select control command indicates what the destination device is supposed to do. For example, for a video cassette recorder this signal may specify whether the recorder must record video or reproduce video, and for a monitor whether the signal format is YUV or RGB, the operation of the monitor depending thereon.

In an embodiment of the system in accordance with the invention, the system is characterized in that the priority code depends on the function of the selected source and/or destination. In such an embodiment a control command "audio-cassette record" sent to a audio cassette recorder may overrule an audio-interconnection and disrupt an audio signal path used by an CD-player. or a control command "VCR-dubbing-record" may overrule an audio-interconnection and disrupt an audio signal path used by the audio cassette recorder for enabling a FM-radio receiver to provide audio signals to the dubbing input of the video cassette recorder. Such priority codes having different levels can be realized by use of a multibit e.g. 6 bits code, wherein the position of the bit in the code is related to the kind of control command (e.g. "VCR-record", "audio-cassette record", "video-play", "audio-play", etc. If so it is very easy to determine priority by bit by bit comparison of the stored priority code and of the received priority code. received by the (sub-)device.

Of course it is possible also to provide a system in accordance with the invention. characterized in that the priority code depends on the kind of application. In such a system the kind of application: pure audio devices; video devices and e.g. security devices such as a camera for supervision of the entrance of a building and a monitor can be regarded as three different application types. each having a different priority level. The security devices can be given the highest priority level.

In a further embodiment of the invention the system is characterized in that the priority code of the connections to be established of a signal path is set by an externally generated control signal of a user of

the system. In a preferred embodiment of the system in accordance with the invention, the system is characterized in that the commands comprising a priority code comprise further a new priority code and in that comparing means have been provided for comparing the received priority code with the stored priority code and which comparing means trigger writing means for writing the new priority code at the location of the priority code in the interconnection table means upon overruling of the stored code by the received priority code. In such a system an interconnection with a high priority is made by use of the appended higher priority code and thereafter is protected by the new priority code stored in the interconnection table means. The use of a priority code and a new priority code, which codes have the same bit format, but may be different in priority level, enables an easy way of handling the information-traffic in the relevant devices (switch boxes) and create a very flexible system.

FURTHER ASPECTS OF THE INVENTION

The invention also relates to a device for use in such system and possibly having various interconnected subdevices, among which at least one switchbox interfacing to other devices.
The invention also relates to a switchbox operating as a device or subdevice.
Further advantageous aspects to the invention are recited in dependent Claims.

BRIEF DESCRIPTION OF THE FIGURES

The invention will be disclosed in more particular detail with respect to the appended drawing, in which:
Figure 1 is a block diagram of an elementary system for use with the invention;
Figure 2 is a more elaborated block diagram of such system;
Figure 3 illustrates a message format;
Figure 4 is a block diagram of a switchbox.

DESCRIPTION OF AN EMBODIMENT AS PREFERRED

Figure 1 is a block diagram of an elementary system for use with the invention. The system comprises three devices 20, 22, 24, among which device 22 is a switchbox. Interconnections 26, 28 are high volume signal interconnections, for example, for digital or analog video signals. Interconnection 30 is a serial control bus for relatively low volume messaged control signals.
Figure 2 is a more elaborated block diagram of an embodiment for use with the invention. The system is typically video-oriented. Of course, audio-oriented, audio/video-mixed, and other orientations would be feasible as well. There are ten devices: satellite tuner 40, video cassette recorders 42, 44, compact disc video players 46, 58, video monitors 54, 56, TV apparatus 52 and switchboxes 48, 50. Video cassette recorder 42 has as subdevices a cassette deck -DECK-, a video tuner TUN, a control element CTR and a local switchbox S8. TV apparatus 52 has as subdevices mnnitor MON, picture-in-picture generator PIP, video amplifier AMP, control element CTR, and local switchbox SB. All devices have a control element CTR. All plugs of devices and/or subdevices to the signal interconnections are numbered. These numbers relate to a locally valid plug sequence. All control devices are attached to single-path control bus 60. This may be a coax, twisted pair or optical bus, for example. The control devices will control various operations of the device and, if applicable, its subdevices. In the embodiment shown the various signal interconnections are all physically separate. Other solutions are possible; for example, interconnections 3 and 5 of switchbox 50 could operate in frequency multiplex with respect to a source signal interconnection of which the frequency band determines which one of monitors 56, 58 is going to effect display. To this effect, the switchbox means may comprise a selectively activatable frequency convertor, or the signal source may already effect such conversion.
Figure 3 illustrates a message format on the control bus. The physical bit shape has been described in the reference. The time has been indicated as curve 140 on which the bits form a contiguous sequence. Start bit 142 is followed by mode indication 144 (1-3 bits) indicating an intended bit cell frequency. Indication 146 contains 12 bits source addres plus parity P. Indication 148 contains a 12 bit slave address plus parity P and acknowledge bit A to be generated by the intended destination on tile control bus, which is not necessarily the destination station of the signal path to be established, where it may also be any intermediate station along this path. Indication 150 is a four bit control signal plus parity P and acknowledge signal A. Indications 152, 154 relate to the data bytes, inclusive of an end-of-data signalization, a parity bit, and an acknowledge bit. Control information 150 relates to the operation of the single channel bus and the control devices CTR connected thereto. Data bytes 152, 154 on this level operate as data that just are

4

transmitted. On the next level, they may operate as either data, address, or control information for the various local (sub)devices.

SPECIFICATION OF SIGNALS AND OPERATION IN A TYPICAL EMBODIMENT

Hereinafter various signals to be used for control functions are specified. and also an example of operation in a typical embodiment. Now, for any plug in a subdevice it is known to which other subdevice and plug on that subdevice it is connected physically. For internal connections between a switchbox subdevice and a signal source or signal destination subdevice all in the same device this is known beforehand (e.g. programmed by the device manufacturer); for external connections (signal connector cables) it is given by the user at initialization time. For systems of low complexity. the necessary information is procured according to the so-called -default- principle that is generally used in personal computers and the like. All (sub)devices comprise interconnection table means for storing for each of its plugs the (sub-)device connected to said plug, the plug of said (sub-)device and the priority code appended to said interconnection. This has been shown in the tables herebelow. notably for the (sub-)devices: SATTUN, VCR1, VCR2, TV, CDV-1, MON-1:

```
I-C TABLE SATTUN                    I-C  TABLE  TV

------------------------            -----------------------------

01  SB-A   01  P-CODE               01   SB-A      05   P-CODE
                                    02   MON       01   ......
------------------------            03   PIP       01   ......
                                    04   AMP       01   ......

I-C TABLE SB-A                      -----------------------------

------------------------

01  SATTUN  01  P-CODE
02  SB-VCR1 03  ......              I-C  TABLE MON2
03  SB-VCR2 03  ......              -----------------------------
04  SB-B    01  ......              01   SB-B      05   P-CODE
05  SB-TV   01  ......              -----------------------------
06  MON-1   01  ......

------------------------            I-C  TABLE SB-B

                                    -----------------------------
I-C TABLE SB-VCR1                   01   SB-A      04   P-CODE
------------------------            02   CDV-1     01   000000
                                    03   CDV-2     01   000000
01  DECK   01  P-CODE               04   -         -    ......
02  TUNER  01  ......               05   MON-2     01   ......
03  SB-A   02  ......               06   -         -    ......

------------------------            -----------------------------
```

In the interconnection table for each (sub-)device is present from left to right: the plugnumber of the (sub-)device, the indication of the (sub-)device connected to said plug. the plug number of the latter (sub-)device used for realizing said connection and the priority of said connection shown in the table as: P-CODE. The priority code can be e.g. a six bit code and the: 000 000 may indicate initialization of the

system. The priority level can be indicated by the position of the bit 1 in the priority code, so that by easy bit by bit comparison the higher level of priority can be found.

Furthermore, any switchbox subdevice knows its current internal interconnections. This means for each of its plugs, the identity of any other plug (zero or more) to which it is currently internally interconnected. All control commands to be specified hereinafter are formatted in the messaged format explained with respect to Figure 3.

To build up a signal interconnection the bus commands Connect and Select are used. Connect is a command for switchbox (sub)devices. It defines a signal interconnection between a plug of that switchbox (sub)device and another (sub)device that is a source or destination of a signal stream. This latter (sub)device may be directly connected to the switchbox (sub)device, or it may be connected via one or more switchboxes in between. The Select command is directed to signal source and signal destination (sub)devices; it informs a signal source (sub)device that it should supply a signal; or a signal destination (sub)device that it will receive a signal; also, further specifying information is included.

To release a signal interconnection the commands Disconnect, Deselect-subdevice and Deselect-plug are used. Disconnect is a command for switchbox (sub)devices and may include a new priority code for resetting the stored priority code. This command has the same operands categories as the Connect command: it is used to release a signal path that has been built with a Connect command. If no new priority code is used the stored priority code is set automatically to zero.

Deselect-subdevice is a command for signal destination (sub)devices and signal source (sub)devices. It is used to inform such a (sub)device that it will not receive a signal anymore, or that it no longer needs to produce signals, respectively.

Deselect-plug is a command for switchbox (sub)devices. It is used to inform the switchbox that the signal path via the given plug is no longer needed. If a deselect command is used then also the priority code of the interconnection to be disconnected is erased (set to zero).

Furthermore, to investigate a current signal interconnection a number of requests are used; these are also transmitted on the control bus.

The Connected request is used to verify if the latest Connect command was successful. It is a request for switchbox (sub)devices.

The Connected-to-subdevices request is a request for signal source and signal destination (sub)devices. It is used to investigate if such a (sub)device is currently active, and if so, to what other (sub)device and plug on that subdevice it has currently a signal interconnection.

The Connected-to-switchbox request is a request for switchbox (sub)devices. It is used to investigate for a given plug of that switchbox, to which other (sub(devices and plugs on these (sub)devices the given plug has currently signal interconnections.

These last two requests (Connected-to-subdevice and Connected-to-switchbox) result in the directly connected subdevices and plugs (if any). The connection in question may be inside the device if switchbox and connected subdevice are both subdevices of the same device, otherwise, it is a signal cable from the switchbox to a plug in another device.

Hereinafter, three examples of the use of the above-mentioned commands will be given:

For example, suppose that CDV-device 46 in Figure 2 wants to play on (TV, PIP) (52) and therefore must make a signal connection to (TV, PIP).

The following control bus commands and requests can be used to achieve this; the bus messages address the devices and subdevices by name; it is not necessary that the message orginator knows where the message destination device is located physically.

CDV (46):
- CDV sends to Switchbox 50 the command Connect plug 2 including a priority code to (TV, PIP).
- CDV sends to Switchbox 50 Request Connected plug 2 to (TV, PIP).
- CDV repeats this question periodically until an answer "Connected" or "Not connected" is received.
Switchbox (50)
- receives bus Connect command from CDV, and therefore issues another bus Connect command including the priority code to switchbox 48 in the same way CDV 46 had done earlier to switchbox 50. The further parameters for the Connect command are plug 4 (of switchbox 48) and (TV, PIP). No other device receives this command, because in switchbox 50 no TV-PIP subdevice is known to be directly connected to switchbox 50 and also, no other switchbox subdevice than switchbox 48 is directly connected to switchbox 50. However, in more complicated situations, it could prove necessary to exectue a tree-like search by means of the bus commands/requests through the interconnected switchbox (sub)devices. It should be noted that there is no à priori restriction to the interconnection pattern of the switchboxes. In connection with the above Connect command, switchbox 50 issues to switchbox 48 the Request connected with the same

parameters (plug 4, TV, PIP). Again, this latter request is repeated until an answer, either "Connected" or "Not connected" is received. If the answer received is "Connected", the switchbox 50 makes internally a connection between its plugs 2 (connected to CDV 46) and 1 (connected to switchbox 48) and the new priority code is stored in the interconnection table means. The answer to the Connected request issued by
5 the CDV 46 is now "Connected". If the answer received by switchbox 50 is "Not connected", switchbox 50 does not make any new interconnection between its plugs. If applicable, any existing interconnection is left active. However, if an interconnection is to be cancelled then its priority code is compared with the received priority code. If the existing interconnection has a lower priority code then it will be cancelled and a new interconnection will be made as demanded by the connect command. If the priority code of the existing
10 interconnection is higher than the received priority code then it will be maintained and no new interconnection will be made. The answer given by switchbox 50 to the Connected request issued by the CDV device 46 is now "Not connected".

Switchbox 48:

15

Switchbox receives the Connect command and the Connected request from switchbox 50. Initially, it does not know to which of the other switchboxes (SB) in devices VCR1 (42), VCR2 (44) and TV (52) the subdevice TV-PIP is actually connected. Therefore, it successively interrogates all of those three switchboxes. As regards the switchbox of TV device 52, the parameters of the command are (plug 1, TV, PIP). As
20 regards the switchbox of device VCR1 (42), the parameters are (plug 3, TV, PIP). The latter command would obviously be not successfull, and upon reception of the ensuing answer "Not connected", the switchbox 48 would, if applicable, turn to interrogating another switchbox. In the case of switchbox TV-SB a "Connected" answer would result depending on the local priority code, if any, and the switchbox 48 will then make the connection between its plugs 4 (connected to switchbox 50) and 5 connected to switchbox
25 SB in device 52. The reaction to a "Not connected" answer has been described earlier.

Switchbox in device TV 52:

This receives the Connect command including the priority code from switchbox 48 and therefore:
30 - issues a Select command to the PIP inside the TV
- makes internal connection plug 1 - plug 3
- (TV, SB) answers in dependence of the priority code, if any present, to a Connected request from switchbox: "Connected".
PIP in TV:
35 - receives the Select command from (TV, SB) and starts displaying the signal received on the signal interconnection now activated.
Next, the operation for changing an interconnection is described. This may imply that in a particular switchbox device one interconnection is made (or a plurality of interconnections is made), while one or more other interconnections are interrupted. For example, say connection 2 -5 holds in the switchbox 48, and the
40 switchbox is changed to connection 2 - 6 (and connection 2 - 5 is now broken, priority is overruled). Now the following commands are issued.
Switchbox:
- because connection to plug 5 of the switchbox is broken: Switchbox to (TV, SB): Deselect-plug 1, set priority code to zero.
45 SB in TV:
- receives the "Deselect-plug 1, set priority code to zero" command from Switchbox.
- say plug 1 of (TV, SB) is currently connected to plug 2 of (TV, SB). Then (TV, SB) issues the command "Deselect-subdevice" to (TV, Mon), because plug 2 of (TV, SB) is connected to (TV, Mon). Mon in TV:
- receives the "Deselect-subdevice" command. This means that it does not receive signal input anymore.
50 Therefore (TV, Mon) may decide to go in standby, for example.
In case the channel to be broken runs through more switchboxes a similar search may be made as the one executed for setting up a connection. However, inasmuch as every (sub)device know its internal connections realized for setting up the path, the search can follow this path and thus be executed more quickly. In conjunction to the disconnection operation, the changed interconnection may be activated in the
55 same manner as described earlier.
Next, the Operation for Tracing an Actual Connection (OTAC) is described.
For example, suppose that the deck of VCR1 (42) wants to know the source of a monitor signal, that is, in fact, provided by Monitor device 56. However, initially this information is not present in device 42. The

following requests are now used. First, the initiating subdevice (VCR1, Deck) issues a Connect-to-Subdevice request to Monitor 56. If this monitor is in an active state, it will then answer that it is connected to plug 5 of switchbox 50. Thereupon, subdevice (VCR1, Deck) issues a "Connected to Switchbox 50, plug 5" request to switchbox 50. In case plugs 1, 5 of switchbox 50 are presently interconnected, switchbox 50 will answer to

5 this request -plug 4 of switchbox 48-. Now, in switchbox 48 plugs 3 and 4 may be interconnected, the former being connected the switchbox subdevice of VCR2 (44). Thus, upon being addressed by means of the "connected to switchbox 48, plug 4 connected-to-subdevice" request, switchbox 48 will answer by "plug 3 of (VCR2, SB)". Finally, subdevice (VCR1, Deck) issues the "connected to switchbox VCR2, SR), plug 3 to subdevice (VCR2, SB). Say, plug 3 of (VCR2, SB) is currently connected to plug 1 of (VCR2, SB).

10 This plug is connected to (VCR2, Deck). Hence (VCR2, SB) answers on the request: (VCR1, Deck).

(VCR1, Deck) now knows that Monitor has a signal connection to (VCR2, Deck). (VCR1, Deck) may now send to (VCR2, Deck) a request to verify if it is active.

Now, the requests and commands contain various operands and control codes, such as the priority code. In a prefered embodiment also a new code is used, which is, as described before, substituted for the

15 priority code stored in the interconnection table means, if said stored code is overruled by the received priority code. The device address normally has twelve bits, subdivided into three fields: the service type (e.g. specifying audio-video devices) of 4 bits, the device type of 5 bits, and the device number of 3 bits. Together with 4 stuffing bits, this fills two message bytes. In similar way, a 10 bit subdevice address is defined. The plug number is specified in one byte; 64 different values are defined. A connect command has

20 one byte opcode, two operands specifying plug number, device/subdevice address of input and output of the connection, and the priority code and the new code, each having six bits, respectively. Disconnect command differs primarily with respect to the opcode. Select command has one byte opcode; it may specify a signal type. No address parameter is necessary. Deselect-subdevice command has similar format Deselect-plug command has the same format, enhanced with a plug number. Connected request has one

25 byte opcode, two operands, specifying plug number and device/subdevice address. The answer contains one or two bytes to the originator of the request, specifying the result. Connected to subdevice request primarily consists of one byte opcode. The answer may specify the following:
- subdevice in standby (only 2 opcode bytes);
- subdevice active; specifying device/subdevice address and signal type communicated with connected

30 (sub)device;
- idem, externally connected to switchbox; specifying device/subdevice, signal type and plug number.
Connected to switchbox request specifies request code and plug number. The answer specifies the plug number(s), and the relevant device/subdevice addresses.

35 EXAMPLE OF A SWITCHBOX DEVICE

Figure 4 is a block diagram of a switchbox (sub)device. Line 134 indicates a single-channel control bus according to the reference. Thereto, element 100 is the interface that accounts for arbitrage on the bit level, recognizing the own address of the switchbox, formatting messages and extracting data. Such data then is

40 sent to byte register 110. Register 110 interfaces to internal bus 132, on which traffic is controlled by processor 130 according to general data processing principles. Generally no specification of address/data/control paths has been given. Processor 130 interrogates register 110, decodes various opcode and other control bytes such as the received priority code as well as the new code and if necessary, controls interconnection of the four signal connections 116...122 by means of cross-bar

45 arrangement 114; by means of two leads 124, 126 two arbitrary pairs can be formed between connections 116...122. The actual control is effected by register 112, that is also loaded by processor 130 via bus 132. The data, such as device/subdevice addresses/plug numbers/signal types and priority codes relating to the four connections 116...122 are memorized in interconnection RAM 128 which has allocated respective storage space to each of connections 116...122. Processor 130 thus continually controls all other elements.

50 With respect to the signals on connections 116...122 the switchbox is organizationally passive. For simplicity, organization on a lower level than processor 130 has not been shown: program store, ALU, instruction decoding, register stack, data RAM, bus interface to bus 132, all generally may be of conventional construction and thus will perform as interrogation and comparison means for interrogating the memory 128 comprising the interconnection table means in order to compare the stored priority code with

55 the received priority code (in 110). Further the processor 130 will perform as code writing means for writing the new code (temporary stored in byte register 110) in the very location of the priority code in the interconnection table means in memory 128 if the received priority code has overruled other stored priority code.

8

The other devices may have a similar set-up. However, inasmuch as they have only one signal interconnection, no cross-bar 114 is necessary and also, other control is simplified. Notably, the interconnection RAM may be replaced by one or only a few hardware registers. On another level, such other devices could be of far greater complexity than the switchbox, but this latter complexity is unrelated to the tactics of the network function.

All of the foregoing has been shown by the way of an example, e.g. it is easy to understand that it is possible to connect a camera (CAM) having an output plug 01 and a controller (CRT) inside to the system shown in figure 2. The output plug (01) could be connected to the switchbox SBB plug 6 and the controller (CRT) to the D2B control bus 60. Then the interconnection table of the camera would be: 01 SB-B 06 P-CODE. The interconnection table of switchbox SBB would change for its plug 6 and would be: 06 CAM 01 P-CODE. If the camera is used for security purposes then it can be given a fixed high priority e.g. P-CODE = 100.000. Then upon detection of a motion or of infra red radiation by a suitable detector the camera is switched on and the supervised area is imaged on MON1 and e.g. recorded on VCR2. The signal path from the camera to VCR2 will be created with the highest priority.

Claims

1. Local communication bus system comprising a serial control bus attached to a plurality of devices that furthermore are plug to plug pairwise interconnected by respective signal interconnections and include at least one plural-plug switchbox means, said system for establishing and specifying a signal path between a source device and a destination device comprising:
- in each respective device, interconnection table means interrogatibly storing information indicating any other device pairwise interconnected to said respective device, and the plug pair so interconnecting that other device and a priority code if any for each interconnection;
- in said source device first message generating means for generating, in case said source device and destination device are not pairwise interconnected, on said control bus a messaged Connect control command including a priority code directed to any first switchbox means pairwise connected to said source device and indicating said destination device as well as a priorty of the connection to be made and in conjunction therewith a messaged Select control command directed to said destination device for thereto signalling and specifying said establishing;
- in the first switchbox means so directed at, interrogating means for interrogating its interconnection table means for identifying the plug connected to said destination device if any and for interrogating the stored priority code if any, and control means for comparing the stored priority code and the received priority code and for in the negative case controlling said first switchbox means as secondary source device for producing a further Connect control command including said received priority code to any second switchbox means connected thereto, until after a first sequence of such Connect control commands the destination device is reached, thereby said path is identified as a second sequence of such pairwise interconnections, between associated plug pairs, starting from said source device and terminating in said destination device, whereby said destination device is activated by said Select control signal for effecting the intended signal transfer, said system comprising activating means for in an initializing state activating said interconnection table means.

2. A system as claimed in Claim 1, characterized in that, the priority code depends on the function of the selected source and/or destination.

3. A system as claimed in Claim 1, characterized in that, the priority code depends on the kind of application.

4. A system as claimed in Claim 1, characterized in that, the priority code of the connections to be established for a signal path is set by an externally generated control signal of a user of the system.

5. A system as claimed in one of the Claims 1, 2, 3 or 4, characterized in that the commands comprising a priority code comprise further a new code and in that comparing means have been provided for comparing the received priority code with the stored priority code and which comparing means trigger writing means for writing the new code at the location of the priority code in the interconnection table means upon overruling of the stored code by the received priority code.

6. A local communication bus system as claimed in any one of the Claims 1 to 5, wherein said source device has second message generating means for generating on said control bus a messaged Disconnect control command to said first switchbox and indicating said destination device, and in conjunction therewith a messaged first Deselect control command for to said destination device signalling said signal path as disconnectable; and wherein the first switchbox means so directed at has repeat means for repeating said interrogating for identifying said plug for release, and in the negative case generating a further messaged

9

Disconnect control command to said further switchbox means until said path is reidentified for releasing any device located within said path, thereby deactivating said destination device with respect to said path, whereby the priority code is set to zero for the relevant interconnectinns to be cancelled.

7. A system as claimed in Claim 1, 2, 3, 4, 5 or 6, wherein said first message generating means comprise first producing means, for producing a Connect command including a priority code specifying an intended signal path with a given priority between a particular plug of a switchbox subdevice and a particular destination (sub)device, and second producing means for producing a Select command informing said destination (sub)device of an intended signal transfer, and specifying such transfer.

8. A system as claimed in Claim 6, wherein said second message generating means comprise third producing means for producing a Disconnect command specifying an abandonable signal path between a particular plug of a switchbox (sub)device and a particular destination (sub)device, fourth producing means for producing a Deselect-subdevice command informing the destination (sub)device of a terminatable signal transfer, and fifth producing means for producing a Deselect plug command informing a particular switchbox means of a terminatable signal transfer with respect to a particular plug of the latter switchbox means, the switch box (sub)device(s) and switch box means comprising resetting means for resetting the priority code of an interconnection of the abandonable signal path upon receipt of said Disconnect command and Deselect plug command respectively.

9. A device for use as a source device in a system as claimed in either of Claims 1 to 8, wherein said first message generating means has sixth producing means for after said Control command persistently producing a Connected Request signal to evoke either a positive or a negative answer from said destination (sub)device or any other (sub)device in said second sequence, the device further comprising interconnection table means for a storing priority code for each plug on the device enabling an interconnection.

10. A device for use in a system as claimed in any of Claims 1 to 8, comprising seventh producing means for producing a Connected-to-subdevice request signal for investigating an activity of a particular (sub)-device and in an active situation thereof investigating to which plug on which other (sub)device the particular (sub)device was communicating.

11. A device for use in a system as claimed in any of Claims 1 to 8, comprising eighth producing means for producing a Connected-to-switchbox request signal for investigating for a particular plug of a particular switchbox means to which other (sub)device and plug(s) on these other subdevices the particular plug has an active signal interconnection.

12. A device for use in a system as claimed in one of the Claims 1 to 8, comprising a switchbox subdevice and at least two further subdevices, said further subdevices being pairwise connected to said switchbox subdevice by means of respective signal interconnections, said switchbox subdevice realizing any signal connection outside said device, said switchbox subdevice having interconnection table means containing a table indicating any subdevice and plug pair interconnected within said device as well as a priority code for each possible plug pair interconnection.

13. Switchbox means for use in a system as claimed in one of the Claims Claim 1 to 8, wherein said switchbox means has at least three plugs for pairwise connection to at least as many other (sub)devices and further comprises a buffer register for storing received commands, addresses, and a priority code, a processor and a memory for storing at least an interconnection table including a priority code for each possible interconnection.
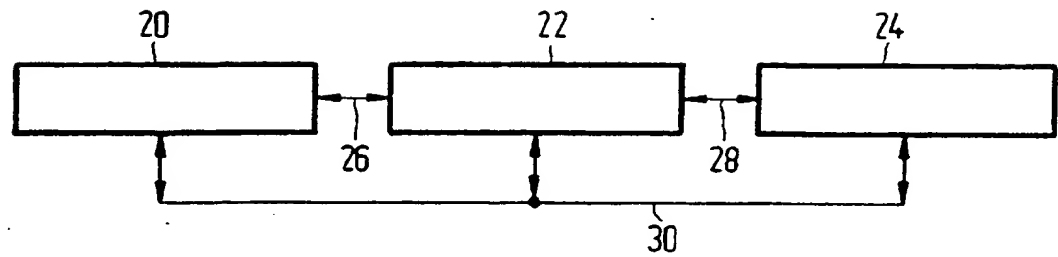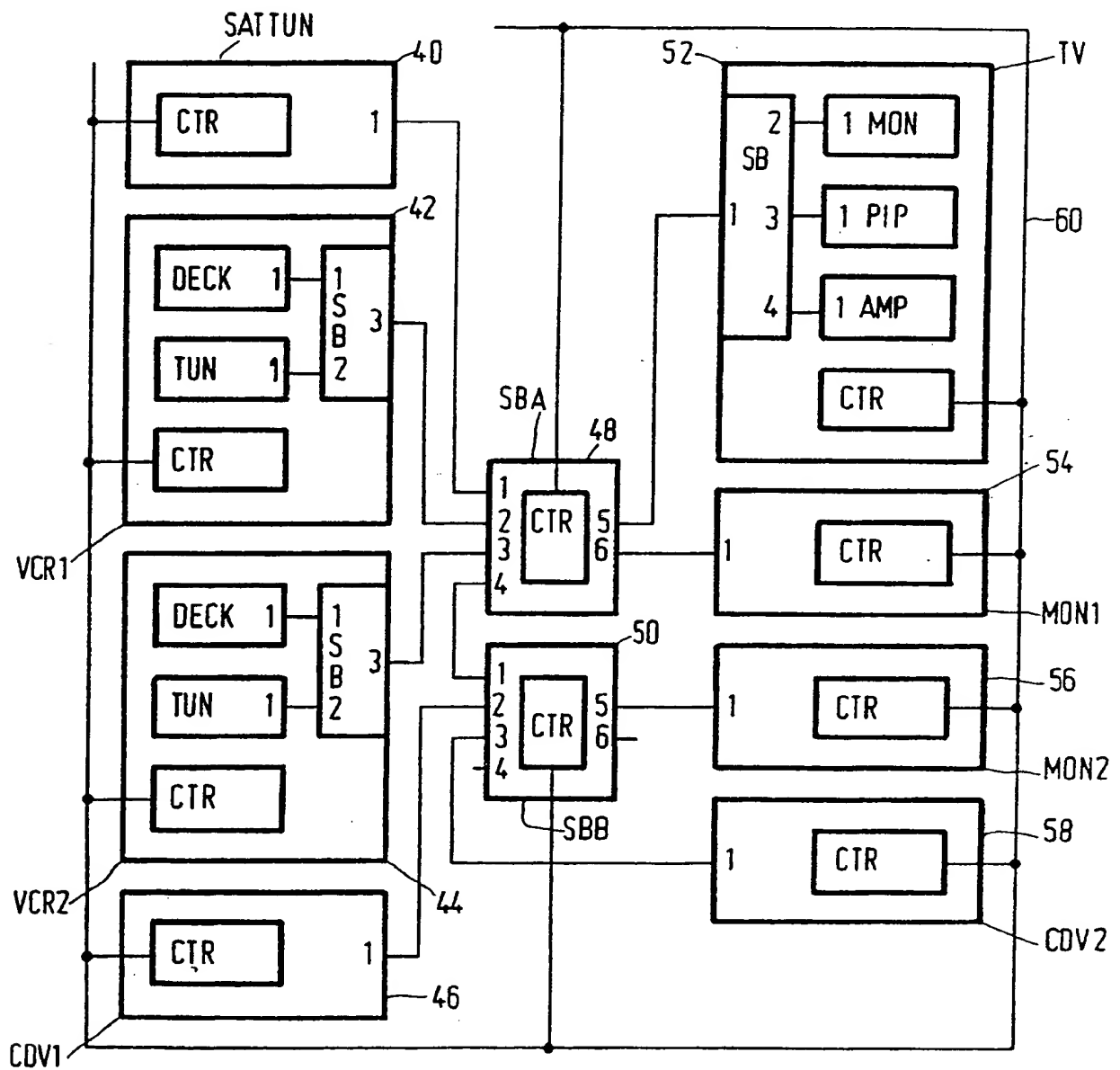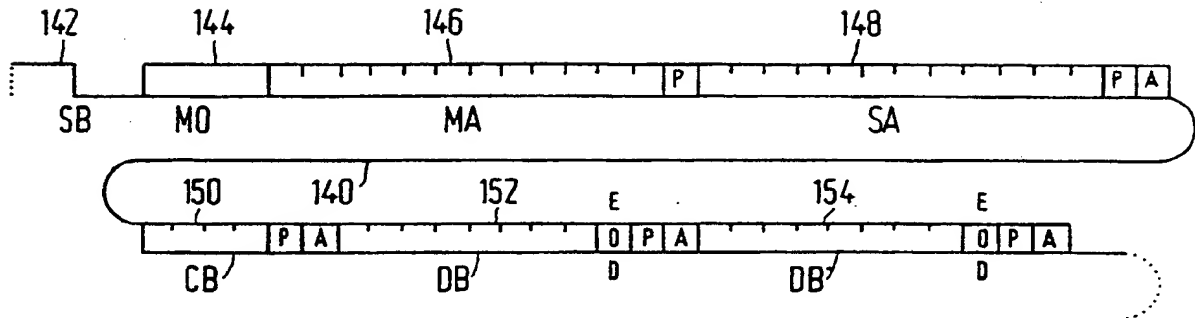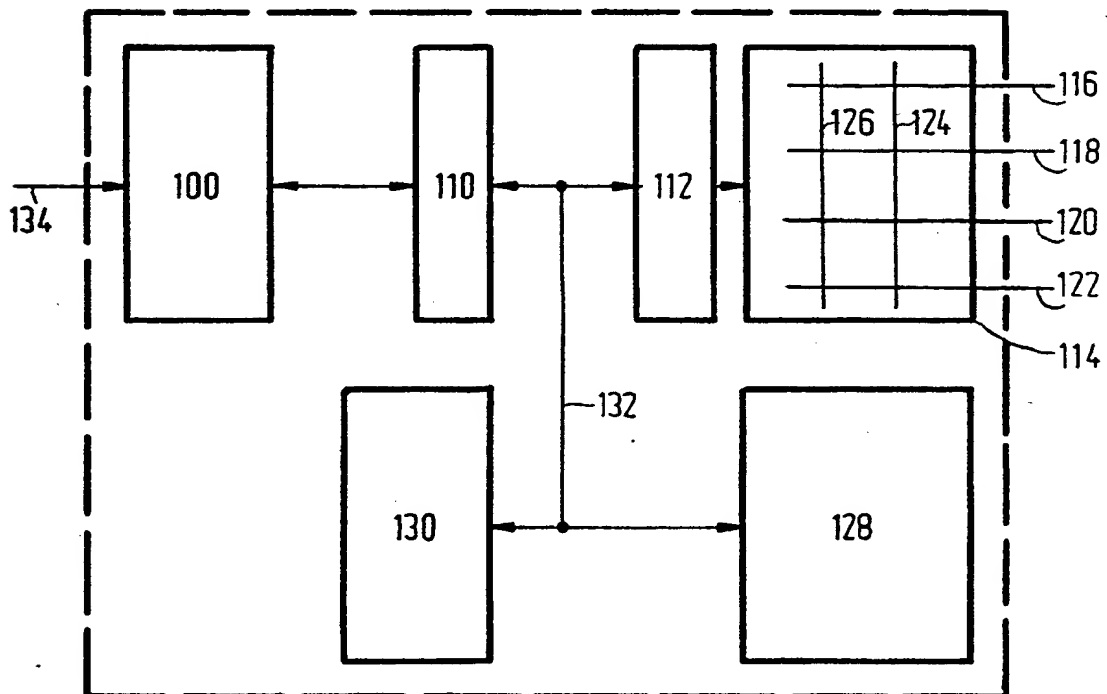
45

50

55

FIG.1

FIG. 2

FIG.3

FIG.4

DOCUMENTS CONSIDERED TO BE RELEVANT

Category	Citation of document with indication, where appropriate, of relevant passages	Relevant to claim	CLASSIFICATION OF THE APPLICATION (Int. CL5)
A	EP-A-257684 (PHILIPS) * column 4, line 24 - column 8, line 22 * ---	1, 12, 13	H04B1/20
			TECHNICAL FIELDS SEARCHED (Int. Cl5)
			H04B H04L

The present search report has been drawn up for all claims

Place of search	Date of completion of the search	Examiner
THE HAGUE	14 AUGUST 1990	MIKKELSEN C.

CATEGORY OF CITED DOCUMENTS

X : particularly relevant if taken alone
Y : particularly relevant if combined with another
    document of the same category
A : technological background
O : non-written disclosure
P : intermediate document

T : theory or principle underlying the invention
E : earlier patent document, but published on, or
    after the filing date
D : document cited in the application
L : document cited for other reasons

& : member of the same patent family, corresponding
    document

THIS PAGE BLANK (USPTO)